the exhibition of morphia, with perfect quietude, and the regular and proper administration of suitable nourishment are the means to be adopted.

Art. XX. *Instances of some of the rarer Varieties of Morbid Growths, Swellings, &c., connected with the Organs contained within the Abdominal Cavity.* By JOHN W. OGLE, M. D.—The case of a lady is related with a swelling on the right side of the abdomen, five inches to the right of the umbilicus, somewhat oblong in shape, rather firm and consistent in character, which proved obstinate against all the remedies used, and finally disappeared under the persistent use of Brandish's solution of potash. After which forty cases of various abdominal tumours are related, with the post-mortem appearances in each.

Art. XXI. *Report of the Medical Cases admitted during the year* 1866. By R. E. THOMPSON, M. D., Medical Registrar.

Art. XXII. *Report of the Surgical Cases admitted during the year* 1866. By G. C. RING, Surgical Registrar.

These two articles show that 1685 medical cases were admitted, with 195 deaths, and 2153 surgical cases admitted, 49 of which were transferred from the medical wards, and 31 cases were transferred to those wards, with 168 deaths, 22 of which were from pyæmia, and 7 from phagedæna. 253 operations were performed, with 26 deaths. These reports are highly creditable to the hospital, and also to the officers compiling them.

J. L. T.

ART. XXIII.—*On the Formation of so-called Cells in Animal Bodies.* By EDMUND MONTGOMERY, M. D., late Demonstrator of Morbid Anatomy at St. Thomas's Hospital. 8vo. pp. 56. London: John Churchill & Sons, 1867.

THIS essay, a "personal attempt of saving from oblivion a labour upon which has been bestowed much time and attention," was read before the Royal Society in December, 1866, in the proceedings of which a very brief abstract was published. Its object is to prove that many, if not all the varying forms of cells which go to make up the physiological and pathological tissues of the economy, may be artificially produced; that in such artificial production certain stages are passed through which are analogous to transitional forms which the author has observed in the microscopic study of human tissues; and from all this to conclude "that the so-called cells are but modified crystals"—though "modified in such a way as to possess the essential characters of the substances which Prof. Graham, in his most significant classification, has ranged under the head of colloids. They are, from a formative point of view, crystalloid beings; but functionally, they partake altogether of a colloid nature."

These are startling statements, and should, at least, be carefully verified before they are accepted; yet the writer states that they are based upon "many thousand observations."

An idea of these observations may be best obtained by briefly transcribing several of them:—

> "Nuclei in growing tissues, when isolated from the mother-texture, are often surrounded by an irregular, shred-like, granular mass. Out of this would bulge, on the addition of water, a clear bright segment of a globule, increasing more

or less rapidly until it became full-orbed, when it would detach itself and float away an independent body. In this occurrence, which I have very frequently observed, it would seem that some imbibing viscid material was mixed up with another cohesive substance incapable of imbibition. On the addition of water, the former alone expands, being thus drawn out of its connection with the latter until it forms a separate body. Such bodies, as I take it, are not mere albuminous drops, but globules formed by the uniform expansion of a viscid imbibing material. The nucleus, with its shred-like inclosure, remains behind, apparently unaltered. But this is not what always happens under similar conditions. I have occasionally seen a much more interesting result; at times, namely, the clear imbibing material does not separate from the shreddy, granular substance. But the whole mass begins to swell out together, altering its irregular shape, till it has formed itself into a beautiful globule. Nothing could possibly surpass the perfect cell-appearance which is hereby produced. The nucleus, which was formerly the only regular shape amidst an unfashioned flake of granular stuff, becomes now, as by magic, surrounded by a splendid, clear-cut sphere, formed from that self-same amorphous matter, merely by the addition of water. Shapes are hereby produced differing nowise from fully formed cells in other parts of growth. In these cases the cohesiveness of the non-imbibing substance was probably not great enough to resist the expansion of the imbibing ingredient with which it was mixed up." (pp. 10, 11.)

Without pretending to deny these statements, or to say that they are identical with what we have seen, we can only compare the appearances described to the liberation of air-bubbles or oil-globules which have been entangled in tissues, or to the liberation of globules of gas when acetic acid has been added, under the microscope, to tissues containing carbonates. But Dr. Montgomery is too experienced an observer to have committed an error of this kind, and we can therefore only suppose the appearance to have been produced in some other way with which we are not familiar. The second of the phenomena described, which consists in a mere change of form, is nothing more than we may expect to take place as the result of imbibition, without calling to our aid the supposition that "the cohesiveness of the non-imbibing substance was probably not great enough to resist the expansion of the imbibing ingredient with which it was mixed up."

"These component parts, imbibing and non-imbibing, which make up the mass that is soon to encompass the nuclei, though they become at times so widely differentiated as entirely to separate from each other on the addition of water, must, nevertheless, closely resemble one another as regards chemical nature. In some rare instances, namely, the granules of the shreddy mass were *completely* dissolved by the action of water. The resulting globules shone, at first, wholly pellucid. Soon, however, the granules began to re-form, showing molecular motion. Ultimately the entire mass of the globule seemed to undergo coagulation, making up a solidified sphere around the nucleus." (pp. 11, 12.)

These facts, as well as "other striking phenomena" described in the paper, he proposes to account for by an "unequal coagulation."

Having never witnessed, in a very large number of examinations, any phenomena at all analogous to the latter described, involving a solution and re-formation of so-called cell contents, we will not venture a better method of accounting for them, but believe that their infrequency, admitted by the writer himself, should preclude them from being considered representative types of cell formation. One other observation from this first part of the pamphlet:—

"Not only single nuclei, with their appendix of shapeless material, are seen floating about in the juice of cancer, for example, but also clusters of two, three, or more, each such imbedded in a proportionately large mass of granular material. Now, it happens sometimes that on the addition of water, the whole non-nuclear mass of such a cluster swells out, blending into one huge sphere, which incloses two, four, or more nuclei, as the case may be."

"This appearance, so simply produced under one's very eyes, is at once recognized to be identical in shape with some of the mysterious beings which have become so celebrated under the name of mother-cells." (pp. 12, 13.)

Nor is this more than we should expect under the present very generally received notion of *a cell*—that it is a mass of *germinal matter* and *formed material* in a varying proportion, according to the supply of pabulum—that the situation of the germinal matter is central, while that of the formed matter is peripheral, and that a cell-wall, if present at all, is only hardened formed material. These varying shapes are no more than are described by Beale and others as of constant occurrence in the blood-corpuscles, mucous-corpuscles, and other cells. They may terminate in the spherical shape, as described by Dr. Montgomery, or they may go on to more irregular forms whence they started, and finally conclude in these; or sometimes even farther still, elongating at one or more points, until finally a portion separates, and becomes itself a living, growing cell, derived from the original cell. Yet we have the author writing:—

"It must be confessed, that at all these most distinct sights, a flood of doubt is felt to rush in, threatening to sweep away the fondly nurtured belief which is contained in that most pregnant formula, '*omnis cellula e cellulâ.*'"

So, also, he proposes to show that nuclei will be produced by chemical and physical processes, "and there will then remain nowhere within the 'cells' a specific resort for the so-called vital forces." Thus he says:—

"Nuclei in cancers form in chemically transformed fibrous tissue. For instance, in many cancerous growths, the most recently formed portion consists of fibres. If these be traced from the newly-developed surface to deeper, older layers, a stratum will often be reached where the fibres begin to be 'nucleated.' Within the fading fibres very elongated, narrow, oval bodies will be seen at regular intervals. In penetrating still deeper, where the mass gets more and more soft, the oval of the 'nuclei' grows broader and broader, till, in some cases, it becomes a full sphere."

"Evidently," he writes, "there is here a slow chemical process going on, which is by degrees transforming the fibrous substance into a viscid material. The consequence is, that globules strive to form as soon as this material begins to imbibe the surrounding juice. At first, these globules are much compressed by the lateral resistance due to the fibrous matter in which they are still inclosed. But in proportion as the latter softens, they go on expanding Sometimes, however, they get fixed by coagulation in some stage or other of their oval existence. *Thus the nuclei are found, during chemical differentiation, from a primary imbibing portion of the transformed fibrous substance.* The remaining portion, the internuclear part, becomes, as we have already seen, also viscous in its turn, and ends by inclosing the pre-formed nucleus as a secondary globule, the whole forming together the complete typical 'cell.'" (p. 21.)

We believe the first error here lies in the idea expressed, that the deeper layers of cells are the older, and the more superficial fibres are the younger. We believe the reverse to be true, and the varying shapes are probably the result of the same causes, according to which the deeper and younger layers of epithelium are more or less spherical, and the superficial flat and scaly. And as to the rest, we reject it, because it is too unreasonable to be accepted without the most positive demonstration, and such demonstration is here wanting. To say, from the data given, that "*evidently* there is here a slow chemical process going on, which is by degrees transforming the fibrous substance into a viscid material," is evidently, in our opinion, begging the question. It may be said, "Neither can the other theories of formation of tissues be demonstrated to be true." Without attempting to disprove this statement, we can say that few, at least, are as arbitrary as the one proposed by Dr. Montgomery.

The second part of the pamphlet is on the "artificial production of cell-shapes." The fact disclosed by the previous studies alluded to is stated to be this:—

> "There exist plastic materials, viscid imbibing substances, which, by their physical properties, give rise to the formation of those shapes that have been called cells, and that are believed to be the bearers of those peculiar powers known under the name of vital." (p. 30.)

Believing this, the author sets about to find such a substance, and hit upon an *artificial myelin*, which he prepares thus:—

> "About one ounce of concentrated alcohol is added to the yelk of a fresh egg, and well mixed with it. The whole is then heated until it begins to boil, when it is rapidly filtered through a cloth not too dense. The yellow fluid which filters through is left to cool and to evaporate; a sediment remains behind, which is the substance sought for." (p. 30.)

So curious have we been with regard to these facts, that we have had prepared, by a careful pharmaceutist, this substance, according to the formula of Dr. Montgomery, and have repeated his experiments with a view of verifying them, if possible. First we took, as recommended by the author, a small particle of this sediment, and, adding a drop of water, placed it under a quarter of an inch objective. There was at once displayed a most beautiful and interesting picture, to which the description given by Dr. Montgomery is, in the main, correctly applicable; as he states:—

> "From all the free margins of the mass there shoot forth slender tubes, more like nerve tubes than anything else. These tubes grow longer and longer, maintaining their original diameter, till they sometimes stretch over the whole field of the microscope. They must be extremely pliable, for the free end wriggles about, serpent-like, till it generally doubles upon the body of the tube, coiling then around it many times." (p. 31.)

The only exception we can make to this description, and we believe it an unimportant one, is, that in our own examinations, the tubes did not always maintain their original diameter, but contracted and dilated as if to accommodate themselves to increased or diminished lateral pressure; as do red blood-corpuscles, to the movements of which they are also compared by the author. They seemed also, as he says, to possess a central and peripheral constituent, with distinct line of demarcation, never blending with each other, but remaining distinct, though often touching each other, their most marked characteristic being an "unequalled plasticity."

From the occurrence of these phenomena the author infers a *crystalline force*, which he says is counteracted by the admixture of white of egg, which caused the evolution of globules to take place instead of the tubes and shapes before described. This experiment was first slightly, though we believe not essentially, modified by ourselves. Instead of using albumen, we mixed the sediment intimately with glycerine of high specific gravity, when, on addition of water, instead of tubes, "segments of splendid clear cut globules began to form at the free margins." These did not, in our own experiment, replace entirely the formation of tubes, but accompanied it. These phenomena are compared by the author to similar phenomena exhibited by the crystalline lens of small fish on imbibition.

That these globules, however, in any way resemble cell forms, appears to us very far from correct. Any one who is at all familiar with the microscopic appearances of oil-globules of any kind, will recognize these appearances and decide in a moment against any resemblance to cell-forms. That these globules are not due to a "crystallizing tendency," we hope also to show shortly.

Proceeding with his subject, the writer states that "the clear globules produced in the manner above related, would have been more 'cell'-like if, instead of being hyaline, they had had a granular appearance." This he accomplishes by the addition of very dilute nitric acid which precipitated the albumen within the formed globule. This we also repeated, and there seemed to result in many of the globules a granular deposit, though many remained unaltered. Yet even when they were present, their appearance was far from that of the granules of the cell. A more or less closely "packed" appearance may be said to have been characteristic, and the granules themselves were much more highly refractive and transparent than albuminous granules of cells. Fearing lest the modification we made should have altered the conditions, we repeated the latter experiments, using albumen instead of glycerine, when the addition of dilute nitric acid was again attended by the appearance of the granules in some of the globules, though in no increased number, if in as many. There were, possibly, a greater number in which fewer granules were present, though these were very large instead of exceedingly small, as stated by the author. Now, had the slightest imbibition of albumen taken place, a supposition which is at the outset unlikely, from the non-osmotic properties of albumen, there should have been an increased precipitation on the addition of nitric acid, which was very far from being the case.

Even more perfect cell-forms are stated to have been produced by the addition of blood-serum to the prepared myelin. This we also repeated, though without producing the perfect cell-forms containing nuclei and even nucleoli. These latter were obtained, as we interpret the writer (the arrangement of paragraphs involves some uncertainty), by the addition of water to the myelin with which the blood-serum had been intimately incorporated. "On the addition of water, one, or a few small globules would first start into existence. These were at the time imbedded in a film of granular material. By degrees this, together with the globules, would get loosened from the glass slide and float about, the whole resembling exactly those nuclei inclosed in granular flakes which have been described in the first section of this paper" (quoted above).

> "Like these, they would sometimes subsequently assume the globular shape, forming thus the most perfectly 'nucleated cells' that can be imagined. To prevent the likeness from being deficient in the slightest detail, some of the inner globules had formed round a single granule, which then represented the 'nucleolus.'" (p. 36.)

Our own experiments did not exhibit these highly beautiful results. We obtained without difficulty the granular flakes, and occasionally a flake would be seen in which with difficulty could be discerned an internal portion not unlike the remains of a nucleus in a fattily degenerated cell; but by no means distinctive enough to be admitted as evidence in such a case as this. The effect of the intimate admixture of the serum and subsequent addition of water seemed to be the production of a very minute state of division of the oily matter, so that the large drops were reduced to minute drops and granules.

As the result of prolonged action of water upon myelin, bird's-nests-cells are also said to be produced, and we are certain we have seen, as the result of such prolonged action of water, the appearances thus compared. So, also, the writer says, "pus cell-like bodies are formed by allowing the myelin to dry upon a slide, and adding water a second time. The appearances indicated by this description we believe we have also seen, though the resemblance was not so close as Dr. Montgomery's diagram would show.

A very proper question now arises: Can these forms be accounted for upon any other supposition than that of crystallization? We believe they can—that a very simple physical relation between the substance called myelin and the reagents added to it, is entirely adequate to explain all the phenomena. Such relation we believe to be that of *non-miscibility*, accompanied by a *marked difference* in the *refracting power of the two substances.* Thus, when water is added to the myelin, and the shooting out of the tubes takes place, is not the process more or less analogous to the peculiar and varied movements observed when oily substances are poured upon the surface of water? We have here the most rapid movement and the production of the most fantastic forms. And this, admittedly, not by any crystallizing process, but in consequence of the physical relation, the non-miscibility of the water and oil. This occurs when other substances are thrown together which do not mingle immediately, but which subsequently unite; thus, alcohol and water, glycerine and water respond more or less similarly, though of course temporarily, as they are entirely miscible.

Again, the globular forms resulting on the additions of concentrated glycerine or albumen of egg are such because of the greater density of these latter substances, whereby as free a movement of the myelin is not permitted to take place—the resistance to movement is greater, hence globular forms result.

And that the myelin, as prepared by Dr. Montgomery, is not only like oil in microscopical characters as described, but also in its chemical properties, we think, can be shown. Thus, when the myelin tubes had been produced under the microscope, the addition of ether caused their immediate disappearance, showing a great solubility in this fluid. Again, we added some of the myelin, as prepared for us, to ether in a test-tube—an apparent solution resulted immediately, and on filtration the clear golden liquid passed to the other side leaving upon the filter a scarcely perceptible residue of matter deposited from the atmosphere. But to guard against error, we scraped the dust-like matter from the filter, placed it under the microscope, added a drop of water, but no myelin tubes appeared. Hence the substance producing these forms must have passed over in the ethereal solution. Not only this, but we evaporated the ethereal solution to dryness and took a small portion of the residue, placed it upon a glass slide, added a drop of water, and put it under the glass. At first, but a mass of globules appeared, but in a few seconds the so-called *myelin tubes again shot forth*, showing a complete solubility in ether.

The mode of preparation of this substance by Dr. Montgomery would also go to show the same chemical characters. First, concentrated alcohol is added to the yelk of an egg and well mixed, then it is heated to boiling. These processes must remove all of the albumen leaving the *oil* in the yellow fluid obtained by filtration, which is left to cool, evaporate, and produce the "myelin."

We do not think that the author intends by his "myelin," the *protagon* of Hoppe-Seyler and others, which in one of its impure states, was known as *myelin*. The process of preparation and properties are so different that it would seem impossible to mistake them. Thus, according to Hoppe-Seyler (*Handbuch der physiologisch- und pathologisch-chemischen Analyse*) protagon crystallizes in tufts of needle-shaped crystals, and is colourless, odourless, and *insoluble* in *pure ether*, though soluble in ethereal oils, and ethereal solutions of fat by the aid of heat. Its preparation is also by a much more complicated process. Dr. Montgomery states, however, that the discovery of the substance named protagon promises to throw much additional light on the subject. And in naming the situations in which the plastic substance which he calls myelin is found, he says: "Even the brain consists to a great extent of it. The contents of the nerve-tubes are mostly myelin. It enters largely into the composition of the spermatozoa. The crystalline lens contains it in profusion. And it is not unlikely that the blood-corpuscles, all so-called cells, and perhaps also the muscles, owe their configuration and many of their properties to it." These are the situations named by Hoppe-Seyler as those in which the protagon occurs, except the crystalline lens, the cells, and muscles. Protagon is also found, according to the latter writer, in pus-corpuscles and the oil of eggs.

We have thus reviewed these points at some length, because we have been anxious to show, if possible, that not only are these formations, artificially produced by Dr. Montgomery, wanting in analogy to natural vital processes, but also that they are not even due to a chemical process of crystallization. The only point in which an actual resemblance may be said to have existed was in the myelin tubes formed on the addition of water to the myelin, which resembles, more or less, actual nerve matter. And in true nerve matter there is, undoubtedly, a natural myelin more or less similar to the prepared. But even here, a practised eye would very quickly recognize a difference, though we might not by description be able to indicate it, while the physical properties of the substance, as shown by its chemical composition, might account for them. Beyond this, however, we can sincerely state that not a single form could be mistaken for any cell-form which had recently been under the control of vital influences. Bodies possessing all the microscopic characters, and shown to have the chemical characters of oil drops, were alone seen. These in modified forms as the result of emulsification through albumen, either of eggs, or as contained in the serum of the blood, were also present, but bodies which could be taken for living cells, none.

It is a fact, that many more substances, identical with those entering into the tissues of the body, are to-day formed in the laboratory than could be prepared even a few years ago, and we believe that many more will also be prepared, but that living ultimate anatomical elements, call them cells or "organic units," are ever formed like the units of *inorganic* bodies "*by dint of similar inherent qualities*, formed, in fact possessed of all their properties, as necessary modes of appearance, as soon as certain chemical compounds are placed under certain physical conditions," we believe cannot be demonstrated. Some presiding principle, call it organic force, vital force, or natural force, or nature, must be present, controlling or modifying the individual method, but insisting upon the general applicability of that truly pregnant formula—

Omnis cellula e cellulâ.

J. T.